Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 59(3) (2021), 763 – 772 **https://assjm.journals.ekb.eg**

Quality Assessment and Acceptability of Kobeba Produced from Different Fish Meat

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Abstract

The present study was conducted to create fish kobeba samples from mackerel tuna, shrimp and squid meat. Three treatments were manufactured KTU (kobeba from tuna meat in the external and internal filling), KSH (kobeba from tuna meat in the external filling and shrimp meat in the internal filling) and KSQ (kobeba from tuna meat in the external filling and squid meat in the internal filling). Physicochemical, cooking properties, microbiological examination and sensory qualities were evaluated. After looking at the results of this study, it was clear that total volatile nitrogen, tri methyl amine and thiobarbituric acid means were 13.49 mg/100g, 5.06 mg/100g and 0.577 mg malonaldehyde / kg at the end of storage period. KTU was better in value of pH and WHC, but the KSH was better in plasticity. The results of cooking loss, cooking yield, fat retention and moisture retention were 22.71, 77.29, 135.14 and 77.66%. The result of aerobic plate count in KTU 2.11×10^3, KSH 2.29×10^3 and KSQ 2.13×10^3 cfu/g while psychrophilic bacteria 3.15×10^2, 3.12×10^2 and 2.39×10^2, respectively but Salmonella and Total Coliform not detected in all samples. Fish kobeba samples were considered sensory satisfactory at the end of storage period. It can be commercial manufactured, with high-quality marine food sources.

Keywords: Tuna fish, chemical properties, cooking characteristics, microbial examination and storage period.

Introduction

Seafood was an excellent source of protein, minerals and vitamins but low cholesterol and sodium. The demand for seafood was being increased due to the increase in consumption rate by the increased world population and awareness on the nutritional qualities of fishery resources **(Emberg *et al*., 2002**; **Ćirković *et al*., 2002).** In fact, this type of food was rich in essential micronutrients, and polyunsaturated fatty acids that are considered essential nutrients to human health **(Liu *et al*., 2017).** Fish represents an advanced place in the patterns of Egyptian food consumption due to the relatively low prices compared to other animal protein sources. The local production of fish increased from about724 thousand tons in 2000 to 1935 thousand tons in 2018, with an increase of about1211 thousand tons, which represents about 167.26% of the amount of production in 2000 **(Abd El Tawab, 2021).** Composition of fish proteins was better than the composition of proteins of other animals, which was mainly due to more favorable amino acid composition and lots of free amino acids **(Toppe *et al*., 2007; Buchtová *et al*., 2010)**. Good digestibility of fish meat comes from the content of short muscle fibers, lacks scleroproteins, collagen and elastin **(Ćirković *et al*., 2002)**. Tuna was a kind of fish with high protein value, ranging between 22.6 to 26.2 g/100 g meat and low fat **(Kurniasari *et al*., 2019).** Tuna meat owns a tasty flavor and pleasant aroma hence very suitable to be processed as various kinds of processed products. Tuna meat can help lower blood pressure and cholesterol **(Cejas *et al*., 2004).** Crustaceans are an important part of the Mediterranean diet. The beneficial effect of crustacean consumption on human health has been related, among other factors to the high content of fatty acids **(Takuchi and Murakami, 2007).** Shrimp is a popular species which shrimp was a good source of vitamin-B_{12}, A, D as well as the Fe and selenium **(Bhavan *et al*., 2010).** Shrimp had a mild, distinctive flavor and tender texture **(Heu *et al*., 2003)**. Shrimp is a rich source of protein, and its lipids are highly unsaturated compared to those of red meat (**Moura and Tenuta-Filho, 2002).** Squid is widely accepted seafood commodity because of its peculiar palatability, sensory properties. Squid is essential for growth and maintenance of the body **(Ozyurt *et al*., 2006).** Fresh squid is rich in nutrients, but contain a high amount of moisture, which lead to a very short shelf-life ***(*Okos *et al*., 2007).** Seafood products, such as fish fingers and fish burgers could supply a variety of healthy food to increase the per capita consumption **(Elyasi *et al*., 2010).** Fish kobeba was famous popular products which belong to the minced fish products such as fish finger and fish ball and it differs from these products in ingredients and manufacturing method **(Kodous, 2008).** Due to high nutritional value of tuna, shrimp and squid meat, the aim of this study was carried out to utilize of them to produce fish kobeba as a new fish product at Egyptian market. In addition, the physiochemical qualities, microbial load, cooking properties, and sensory evaluation of fish kobeba during frozen storage period at -18°C for 3 months were evaluated.

Materials and methods:

1. Materials:

1.1. Marine fish:

Mackerel tuna fish (*Euthynnus affinis*), shrimp (*Penaeus semisulactus*) and squid (*Loligo vulgaris*) were purchased from local market, Alexandria, Egypt. The fish were put in ice box and immediately transported to laboratory of Food Technology in Food Science and Technology department, Faculty of Home Economic, Al-Azhar University.

1.2. Defatted texturized soybean:

Defatted texturized soy (≤ protein 48% and fat 6%) was obtained from Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

1.3. Other ingredients:

Bulgur, onions, garlic, salt, corn oil and dried natural herbs (black pepper, coriander, cumin, cardamom, cubeb, red pepper and cloves) were purchased from local market, Tanta, Egypt.

1.4. Chemical additives:

Sodium tri polyphosphate was obtained from El-Gomhoria Company for Chemicals and Drugs, Tanta, Egypt.

2. Methods:

2.1. Preparation of tuna fish meat:

Tuna fish were washed with running tap water to remove blood and the black lining in the gut cavity. Afterward, head, skin and boons were removed from all fish then meat was minced by meat mincer (Maulinex, 65, Egypt).

2.2. Preparation of shrimp and squid meat:

Shrimp samples were washed with running tap water to remove any adhering contamination, peeled and meat was minced by meat mincer (Maulinex, 65, Egypt). Squid samples were washed with running tap water, skinned, cleaned and meat was minced by meat mincer (Maulinex, 65, Egypt).

2.3. Preparation of texturized soybean and bulgur:

Defatted texturized soybean was rehydrated by water (at a ratio of 1:2 w / v) for half an hour and grinded by meat mincer (Maulinex, 65, Egypt). While bulgur was cleaned of impurities, wash well with water several times and soaked in water at a ratio of 1:2 (w: v) for two hours then minced with meat mincer (Maulinex, 65, Egypt).

2.4. Preparation of spices mixture:

The dried natural herbs were powdered separately in a laboratory mill (Maulinex, 65, France), and then a mixture of the powdered spices was prepared as follows: (32% black pepper + 22.50 % coriander + 15.0 % cumin + 10.0 % cardamom + 9.0 % red pepper + 7.50% cubeb + 4.0 % clove).

2.5. Preparation of different fish kobeba:

Kobeba was prepared as described by **Mohammed (2017).** Tuna kobeba consists of external filling and internal filling. The external filling prepared by mixed 60% minced tuna meat with 22% bulgur, 8% rehydrated defatted soybean, 4.95% onions 2.0 % salt, 1.5% garlic, 1.5% spices and 0.05% sodium tri polyphosphate. The internal filling (inside external filling) was divided into three treatments according to the type of fish marine which used. The first treatment (KTU) prepared by mixed 65% minced fried tuna fish meat with 33.50% fried minced onion and1.5% spices mixture. The second treatment (KSH) contained fried shrimp meat instead of tuna meat. The third treatment (KSQ) contained fried squid meat instead of tuna meat, as shown Table (1), Fig.(1). Taken 60g of external filling and 10 g of each internal filing were formed manually into oval shape. Kobeba samples were placed on foam plate, wrapped with polyethylene film and stored at -18˚C for 3 months. Kobeba samples were taken for analysis every month periodically.

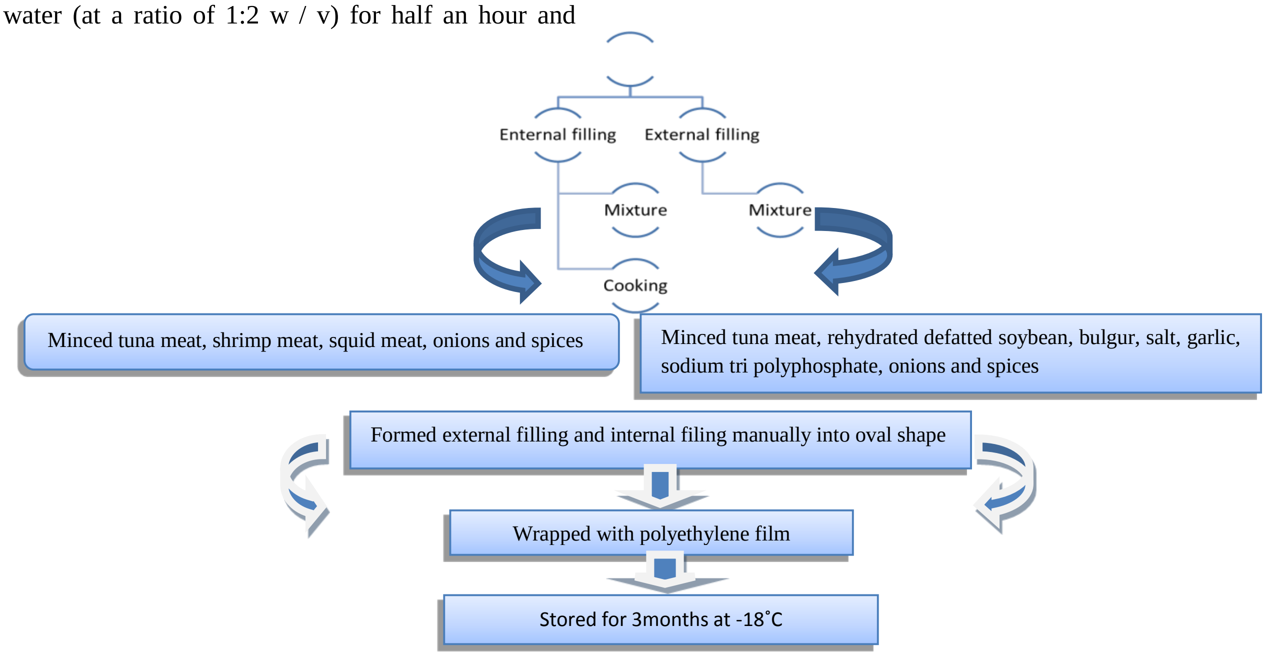

Fig . 1. Schematic diagram of fish kobeba preparation

2.2 6. Analytical methods:

2.2.6.1. Physicochemical properties:

Total volatile nitrogen, trimethylamine and Thiobarbituric acid value contents of samples were determined according to the methods mentioned by **Harold *et al.* (1987).** Water holding capacity and plasticity of samples were measured by the filter press method according to **Soloviev (1966).** pH value was determined according to **(AOAC., 2005).**

Table 1. Ingredients (%) used in the preparation of fish kobeba

Ingredients	Kobeba treatments		
	KTU	**KSH**	**KSQ**
External filling			
Minced tuna meat	**60.00**	**60.00**	**60.00**
Bulgur	**22.00**	**22.00**	**22.00**
Defatted soy flour	**8.00**	**8.00**	**8.00**
Minced onion	**4.95**	**4.95**	**4.95**
Salt	**2.00**	**2.00**	**2.00**
Spices mixture	**1.50**	**1.50**	**1.50**
Minced garlic	**1.50**	**1.50**	**1.50**
Sodium tri polyphosphate	**0.05**	**0.05**	**0.05**
Internal filling			
Fried minced tuna fish	**65.00**	**-**	**-**
Fried minced shrimp	**-**	**65.00**	**-**
Fried minced squid	**-**	**-**	**65.00**
Fried minced onions	**33.50**	**33.50**	**33.50**
Spices mixture	**1.50**	**1.50**	**1.50**

KTU= kobeba from tuna meat in the external and internal filling, KSH= kobeba from tuna meat in the external filling and shrimp meat in the internal filling, KSQ= kobeba from tuna meat in the external filling and squid meat in the internal filling.

2.2.6.2. Cooking properties:

Kobeba samples were thawed at 5°C then fried in deep corn oil for 2-3 minutes for color is light yellow according to **Mohammed (2017).**Cooking loss was calculated the difference in the mass according to **(Niamuy *et al.*, 2008)**.

$$\% \text{ Cooking loss} = \frac{\text{mass befor cooking-mass after cooking}}{\text{mass befor cooking}} \times 100$$

Cooking yield, both fat and moisture retentions values were calculated using the following equations as mentioned by **Carbonell *et al.* (2005)**

$$\text{Cooking yield } (\%) = \frac{\text{weight of cooked samples(g)}}{\text{weight of raw samples (g)}} \times 100$$

$$\text{Fat retention } (\%) = (\%) \text{ cooking yield} \times \frac{\text{fat(\%)in cooked samples}}{\text{fat(\%) in raw samples}} \times 100$$

$$\text{Moisture retention } (\%) = (\%) \text{ cooking yield} \times \frac{\text{moisture (\%) in cooked samples}}{\text{moisture (\%) in raw samples}} \times 100$$

2.2.6.3. Microbiological examination:

Fish kobeba samples were prepared using the recommended methods by American Public Health Association **(APHA., 1976)**. Total viable bacterial count, psychrophilic bacteria and Coliforms group bacteria were determined by **(Difco, 1984).** Salmonella *spp* count of samples was detected by **(Bryan, 1991).**

2.2.6.4. Sensory evaluation:

Sensory evaluation of fish kobeba was carried out by panelists from Food Science and Technology department, Faculty of Home Economic, Al-Azhar University. The panelists were asked to evaluate taste, odor, texture, color and overall acceptability on 1 to 10 hedonic scales as described by **Mohammed (2017).** A score of 1 is being disliked extremely and 10 being extremely.

Statistical analysis:

Statistical analysis was conducted using Costat version 6.311 (Copyright 1998-2005, CoHort software). When a significant main effect was detected, the means were separated with the Way Completel Randomized test. The predetermined acceptable level of probability was 5% ($P \leq 0.05$) for all comparisons according to **Snedecor and Cochran (1994)**.

Results and Discussion

3.1. Physicochemical properties of fish kobeba during storage period at -18˚C for 3months:

Total volatile nitrogen (TVN), trimethylamin (TMA), thiobarbituric acid (TBA), pH value, water holding capacity (WHC) and plasticity values were widely used as physicochemical parameters to assess the quality and storage stability of fishery products. According to statistical analysis of data in Table (2) it could be noticed that total volatile nitrogen (TVN), thiobarbituric acid (TBA) and pH values of fish kobeba treatments were significantly affected (p≤0.05) by the type of fish meat used in internal part (internal filling) and frozen storage period at – 18ºC. On the contrary, trimethylamin (TMA), water holding capacity (WHC) and plasticity were not affected (p > 0.05) by the type of fish meat but significantly affected by frozen storage period at – 18ºC.

Table 2. Physicochemical properties of fish kobeba treatments during storage period at -18°C for 3months

Properties	Storage period (month)	Treatments			Mean
		KTU	KSH	KSQ	
TVN (mg /100 g)	**Zero time**	11.62±0.83	10.25±1.16	9.97±0.63	10.61^{B}±0.96
	1	12.03±0.92	11.12±1.03	10.16±0.77	11.10^{B}±0.77
	2	13.60±0.42	12.05±2.04	11.37±2.13	12.34^{AB}±1.54
	3	14.75±2.17	13.12±3.06	12.61±1.85	13.49^{A}±2.05
	Mean	13.00^{a}±2.11	11.64^{ab}±1.07	11.02^{b}±0.89	
		LSD for treatments		1.7	
		LSD for storage periods		1.9	
TMA (mg/100g)	**Zero time**	1.29±0.13	1.80±0.16	1.55±0.33	1.55^{C}±0.09
	1	2.13±1.01	2.36±0.52	2.15±0.78	2.21^{BC}±0.18
	2	3.11±0.69	3.27±1.35	3.16±1.48	3.18^{B}±0.44
	3	4.15±2.29	5.83±1.92	5.20±1.63	5.06^{A}±1.81
	Mean	2.67^{a}±0.64	3.32^{a}±0.76	3.02^{a}±1.01	
		LSD for treatments		1.03	
		LSD for storage periods		1.20	
TBA (mg malonaldehyde / kg)	Zero time	0.350±0.05	0.257±0.02	0.230±0.05	0.279^{C}±0.03
	1	0.407±0.06	0.294±0.01	0.264±0.03	0.322^{C}±0.08
	2	0.584±0.02	0.339±0.07	0.317±0.08	0.413^{B}±0.02
	3	0.713±0.07	0.516±0.09	0.501±0.04	0.577^{A}±0.07
	Mean	0.513^{a}±0.09	0.353^{b}±0.01	0.328^{b}±0.06	
		LSD for treatments		0.04	
		LSD for storage periods		0.05	
pH value	**Zero time**	5.22±0.13	5.43±0.21	5.57±0.18	5.40^{B}±0.20
	1	5.26±0.31	5.50±0.36	5.67±0.11	5.47^{B}±0.27
	2	5.38±0.09	5.58±0.12	5.77±0.03	5.57^{AB}±0.23
	3	5.49±0.16	5.65±0.20	5.88±0.14	5.67^{A}±0.14
	Mean	5.34^{c}±0.15	5.54^{b}±0.19	5.72^{a}±0.17	
		LSD for treatments		0.2	
		LSD for storage periods		0.2	
WHC (cm^2/0.3g)	**Zero time**	1.60±0.12	1.70±0.11	1.79±0.29	1.70^{C}±0.23
	1	1.95±0.16	2.00±0.09	2.10±1.04	2.02^{C}±0.80
	2	2.37±0.41	2.89±0.14	3.02±0.88	2.76^{B}±0.51
	3	3.45±0.21	3.60±0.06	3.81±1.01	3.62^{A}±0.72
	Mean	2.34^{a}±0.23	2.55^{a}±0.24	2.68^{a}±0.75	
		LSD for treatments		0.4	
		LSD for storage periods		0.5	
Plasticity (cm^2/0.3g)	**Zero time**	4.40±0.18	4.65±1.03	4.55±0.15	4.53^{A}±0.71
	1	4.36±0.88	4.60±0.92	4.49±0.57	4.48^{A}±0.71
	2	3.77±1.01	3.53±0.30	3.88±0.22	3.72^{B}±0.54
	3	3.12±0.80	3.22±0.60	3.15±0.87	3.16^{B}±0.44
	Mean	3.91^{a}±0.58	4.00^{a}±0.61	4.02^{a}±0.63	
		LSD for treatment	0.6		
		LSD for storage periods	0.7		

LSD= Least Significant Difference (LSD p≤0.05),TVN=Total volatile nitrogen, TMA= Tri methyl amine, TBA= Thiobarbeturic acid. WHC= water holding capacity, KTU= kobeba from tuna meat in the external and internal filling, KSH= kobeba from tuna meat in the external filling and shrimp meat in the internal filling, KSQ= kobeba from tuna meat in the external filling and squid meat in the internal filling.

The mean values of TVN for all fish kobeba ranged from 11.02 to 13.0 mg / 100g. Fish kobeba prepared with squid (KSQ) had significantly lower TVN (11.02 mg/100g) than kobeba prepared with tuna meat (KTU) but lower than kobeba prepared with shrimp (KSH) with non-significant differences ($p>0.05$) between them. These results agree with **Kadous (2008)** who found that TVN of kobeba prepared from squid and shrimp was 11.35 and 11.5 mg/100g, respectively. Also, the mean values of TVN for all fish kobeba immediately after processing or at zero time (10.61mg/100g) was significantly ($p\leq0.05$) increased by increasing storage periods to 13.49 mg/100g after 3 months of storage at - 18°C. This increase in TVN during storage was attributed to the activity of microbial which breakdown protein to volatile nitrogenous compounds as reported by **Chomnawa *et al*. (2007).** Generally, total volatile nitrogen of different fish Kobeba prepared in the present study at any time of storage were within the acceptable limit (35-40 mg N/100g) reported by **Mathew (2003) and Arashisara *et al*. (2004)** for fish muscle.

The mean TMA values of all fish kobeba treatments during storage was ranged from 2.67 to 3.02 mg /100g which showed non-significant differences ($p>0.05$) between them. Also, the initial mean value of TMA (1.55mg/100g) significantly increased by frozen storage period increment which reached to 2.21, 3.18 and 5.06 mg/100 g after 1, 2 and 3 months, respectively. On the other hand, there was no significant difference in TMA values between zero time and the 1 month, also between the 1 and 2 months but there was significant between 1 and 3months. TMA is a reduction product of TMAO (trimethylamine oxide) decomposition due to bacterial spoilage and enzymatic activity **(Serdaroğlu and Deniz, 2001).**

The TBA value is widely used as an indicator of the degree of lipid oxidation **(Tokur *et al*., 2006).** Fish kobeba prepared with tuna (KTU) had significantly higher TBA value (0.513 mg malonaldhyde/kg) than other kobeba treatments. The lowest TBA value (0.328 mg malonaldhyde /kg) was recorded for KSQ followed by KSH with non-significant differences between them. Mean values of TBA for fish kobeba treatments significantly increased from 0.279 at zero time to 0.577 mg malonaldhyde /kg at the end of storage period. This increase might be due to the development of oxidative rancidity in fish product **(Izci, 2010)**. These results agree with **Kadous (2008)** found that TBA of kobeba prepared from squid and shrimp was 0.350 and 0.340 mg malonaldhde/kg, respectively.

The mean pH values of all fish kobeba ranged from 5.34 to 5.72. The highest pH value (5.72) was recorded for KSQ followed by KSH (5.54) and KTU (5.34) without significant differences ($p>0.05$) between them. The initial mean value of pH for all kobeba (5.40) significantly increased by increasing storage period being 5.67 after 3 months of frozen storage. The increase of pH values during storage might be reason to produce volatile basic components such as ammonia and total volatile nitrogen by spoilage bacteria (**Lawrie and Ledward, 2006).**

The water holding capacity (WHC) is defined as the ability of meat and meat products to bind water **(Pearce *et al*., 2011).** Also, the plasticity of meat samples indicates the tenderness of meat (**Mohammed 2017)**. No significant differences ($p>0.05$) were recorded between mean values of WHC (2.34 – 2.68 cm^2/0.3g) and plasticity (3.91-4.02 cm^2/0.3g) for all kobeba treatments during storage. The best water holding capacity (i.e., lowest value) and plasticity was recorded for KTU (2.34 cm2/0.3g) and KSQ (4.02 cm2/0.3g), respectively. During frozen storage, the water holding capacity and plasticity of fish kobeba were decreased significantly (i.e., separated free water increased from 1.70 to 3.62 cm^2/0.3g for WHC and from 4.53 to 3.16 cm^2/0.3g for plasticity) with advancement of storage time. The loss of WHC and plasticity during storage may be attributed to protein denaturation and loss of protein solubility (**El-Kordy, 2006).**

3.2. Cooking characteristics of fish kobeba during storage period at -18°C for 3months:

From data in Table (3), it could be observed that cooking loss, cooking yield, fat and water retentions of kobeba treatments were significantly affected ($p\leq0.05$) by the type of fish meat used in internal part (internal filling) and frozen storage period at – 18ºC. Cooking loss indicates the amount of water which is lost during cooking.

Therefore, it is associated with water holding capacity of the meat **(Park *et al.*, 2013 and Alakhrash *et al.*, 2016).** The KSQ had significantly higher mean values of cooking loss (23.37%) than other fish kobeba treatments (KTU and KSH) during frozen storage periods. The highest mean values of cooking yield (79.72%), fat retention (135.44%) and water retention (77.47) were recorded for fish kobeba prepared with tuna (KTU) followed by kobeba prepared with shrimp (KSH) and squid (KSQ) with significant differences ($p\leq0.05$) between them.

Also, mean values of cooking loss, cooking yield, fat retention and water retention of kobeba treatments were significantly increased from 20.59, 79.41, 131.97 and 75.33%, respectively at zero time to 22.71, 77.29, 135.14 and 77.66%, respectively after 3 months of frozen storage at – 18°C. The increase of cooking loss during storage periods might be attributed to protein denaturation and the loss of protein solubility **(Carroll *et al*. 2007)**. This increase of cooking loss during storage period supported by increasing of WHC values reported in **Table (2)**. Also, the increase of fat and water retention may be related to the ability of protein matrix to retain water and bind fat **(Bochi *et al.*, 2008).** In this concern, **Mohammed (2017)** who found that water retention and fat retention of chicken kobeba were 74.11% and 129.44%, respectively at zero time and increased to 74.55% and 129.49%, after 5months of frozen storage period at -18°C.

Table 3. Cooking characteristics of fish kobeba treatments during storage period frozen at -18°C for 3months

Characteristic	Storage period (month)	Treatments			Mean
		KTU	KSH	KSQ	
Cooking loss%	**Zero time**	19.37±1.13	20.11±0.73	22.29±1.02	20.59^{B}±1.61
	1	19.85±0.91	20.91±2.03	22.98±0.73	21.25^{B}±1.71
	2	20.72±1.14	21.27±2.11	23.71±0.28	21.90^{AB}±1.97
	3	21.19±3.04	22.46±0.82	24.49±0.42	22.71^{A}±2.19
	Mean	20.28^{b}±2.19	21.19^{b}±2.00	23.37^{a}±1.85	
		LSD for treatments		1.2	
		LSD for storage periods		1.4	
Cooking yield%	**Zero time**	80.63±0.13	79.89±1.22	77.71±0.17	79.41^{A}±1.40
	1	80.15±0.91	79.09±2.16	77.02±0.35	78.75^{AB}±1.77
	2	79.28±0.11	78.73±0.79	76.29±0.32	78.10^{BC}±1.28
	3	78.81±0.66	77.54±0.83	75.51±1.11	77.29^{C}±1.42
	Mean	79.72^{a}±1.93	78.81^{b}±1.56	76.63^{c}±1.12	
		LSD for treatments		0.8	
		LSD for storage periods		0.9	
Fat retention%	**Zero time**	133.39±2.13	132.86±0.79	129.66±1.12	131.97^{C}±8.73
	1	134.53±0.89	133.29±2.21	130.36±3.06	132.73^{BC}±8.48
	2	135.91±0.56	134.13±0.77	131.24±1.17	133.76^{AB}±8.43
	3	137.92±0.27	135.50±0.53	132.01±1.45	135.14^{A}±9.72
	Mean	135.44^{a}±1.95	133.95^{b}±2.22	130.82^{c}±2.30	
		LSD for treatments		1.2	
		LSD for storage periods		1.4	
Moisture retention%	**Zero time**	76.07±0.33	75.90±1.13	74.03±2.03	75.33^{C}±1.81
	1	77.34±0.63	77.03±0.50	75.04±0.54	76.47^{BC}±1.48
	2	77.67±1.18	78.17±1.21	75.65±2.15	77.16^{AB}±2.13
	3	78.81±2.19	78.53±0.33	75.89±0.47	77.66^{A}±1.84
	Mean	77.47^{a}±1.35	77.41^{a}±1.00	75.15^{b}±1.56	
		LSD for treatments		1.06	
		LSD for storage periods		1.2	

LSD=Least Significant Difference (LSD p≤0.05), KTU= kobeba from tuna meat in the external and internal filling, KSH= kobeba from tuna meat in the external filling and shrimp meat in the internal filling, KSQ= kobeba from tuna meat in the external filling and squid meat in the internal filling

3.3. Microbiological examination of fish kobeba during storage period at -18°C for 3months:

Aerobic plate count, psychrophilic bacteria, total coliform count, salmonella spp. and total mold and yeast of kobeba samples during storage period at -18C for 3 months are presented in **Table (4).** Results from this **Table** obtained that total aerobic plate count of KTU, KSH and KSQ was 3.45×10^3, $3.60\times10^3$and 3.21×10^3 cfu/g at zero time these counts were decreased to 2.11×10^3, 2.29×10^3 and 2.13×10^3 respectively, at the end storage period. Also, psychrophilic bacteria count immediately after processing were 7.10×10^2, 7.30×10^2 and 6.88×10^2 cfu/g for KTU, KSH and KSQ, also, these counts decreased to, 3.15×10^2, 3.12×10^2 and 2.39×10^2 cfu/g, respectively at the end of the storage period. **Mohammed (2017)** reported that total bacterial count and psychrophilic bacteria of chicken kobeba were 8.77×10^4 and 7.63×10^3, respectively at zero time and reached to 6.94×10^4 and 6.32×10^3, respectively after 5 months of storage at -18°C. Also, **Abou-Taleb *et al*. (2019)** found that total bacteria count of frozen chips from tuna 2.09×10^4.

The obtained results indicated that total mold and yeast count at zero time was high in KSQ (8×10 cfu/g) compared with KSH and KSQ. Mold and yeast counts were decreased during storage period. At the end of the storage period, mold and yeast count was 3×10, 4×10 and 5×10 cfu/g for KTU, KSH and KSQ, respectively. As it can be seen from data, all fish kobeba were completely free from *Salmonella spp.* and coliform bacteria immediately after processing and during storage period at – 18°C. The reduction of total microorganism count during frozen storage might be due to the breakdown of microorganism cell wall by ice-crystals formed during frozen process **(Taha, 2012).**

Table 4. Microbilogical examination (cfu/g) of fish kobeba treatments during storage period at -18°C for 3months

Microorganisms	Storage period (month)	Treatments		
		KTU	KSH	KSQ
Aerobic plate count	Zero time	3.45×10^3	3.60×10^3	3.21×10^3
	1	3.21×10^3	3.53×10^3	3.17×10^3
	2	2.18×10^3	2.42×10^3	2.16×10^3
	3	2.11×10^3	2.29×10^3	2.13×10^3
Psychrophilic bacteria	Zero time	7.10×10^2	7.30×10^2	6.88×10^2
	1	6.30×10^2	6.75×10^2	5.37×10^2
	2	5.10×10^2	5.26×10^2	4.19×10^2
	3	3.15×10^2	3.12×10^2	2.39×10^2
Total coliform count	Zero time and 3moths	ND	ND	ND
Salmonella spp.	Zero time and 3moths	ND	ND	ND
Mold and yeast	Zero time	6×10	7×10	8×10
	1	5×10	6×10	7×10
	2	4×10	5×10	6×10
	3	3×10	4×10	S×10

ND= not detected, Cfu/g= Colony Forming Unit/gram, KTU= kobeba from tuna meat in the external and internal filling, KSH= kobeba from tuna meat in the external filling and shrimp meat in the internal filling, KSQ= kobeba from tuna meat in the external filling and squid meat in the internal filling

3.4. Sensory evaluation of fish kobeba during storage period at -18°C for 3months:

Sensory properties are generally the final guide to evaluate the quality from the consumer's point of view **(Moghazy, 2014).** According to statistical analysis of data in **Table (5)** it could be noticed sensory properties (taste, odor, color, texture and overall acceptability) of fish kobeba were not affected (p>0.05) by the type of fish meat used in internal part (internal filling). The mean scores of sensory properties for all fish kobeba (KTU, KSH and KSQ) were ranged from 7.68 to 7.78 for taste, 7.74 to 7.88 for odor, 8.14 to 8.35 for color, 7.70 to 7.93 for texture and 7.76 to 8.00 for overall acceptability without significant differences (p>0.05) between them.

On the other hand, sensory properties of fish kobeba were significantly affected (p≤0.05) by frozen storage period at – 18ºC. The initial mean scores of taste (8.37), odor (8.40), color (8.73), texture (8.37) and overall acceptability (8.43) for fish kobeba were significantly decreased by increasing storage periods at – 18ºC up to 6.97, 7.17, 8.01 and 7.38, respectively after 3months of storage. This decrease in sensory properties of kobeba during storage might be due to formation of some volatile low molecular weight compounds, lipid oxidation and protein degradation during frozen storage **(Undeland and Lingnert, 1999)** adapted by **(Pawar *et al*., 2013)**. Also, texture deterioration, which occurs in fish upon freezing, is due to denaturation of protein **(Mohan *et al*., 2018).**

Table 5. Sensory evaluation of fish kobeba treatments during storage period at -18°C for 3months

properties	Storage period (month)	Treatments			Mean
		KTU	KSH	KSQ	
Color	Zero time	8.70±0.49	8.90±0.74	8.60±0.34	8.73^{A}±0.68
	1	8.40±0.70	8.50±0.53	8.15±0.52	8.35^{AB}±0.50
	2	8.30±0.67	8.50±0.58	7.90±0.74	8.23^{AB}±0.70
	3	8.00±0.82	8.15±0.71	7.90±0.17	8.01^{B}±0.73
	Mean	8.35^{a}±0.70	8.51^{a}±0.67	8.14^{a}±0.65	
		LSD for treatments		0.5	
		LSD for storage periods		0.6	
Odor	Zero time	8.50±1.03	8.60±0.52	8.10±0.99	8.40^{A}±0.88
	1	8.20±0.53	8.00±0.67	7.88±0. 15	8.02^{AB}±0.73
	2	7.50±0.85	7.45±0.76	7.85±0.57	7.60^{B}±0.74
	3	7.30±1.06	6.90±0.74	7.30±1.06	7.17^{C}±0.95
	Mean	7.88^{a}±0.79	7.74^{a}±0.61	7.78^{a}±0.91	
		LSD for treatments		0.6	
		LSD for storage periods		0.7	
Taste	Zero time	8.40±0.99	8.70±0.82	8.00±0.67	
	1	8.10±0.52	7.90±0.57	7.90±0.88	7.97^{AB}±0.70
	2	7.60±0.84	7.25±0.86	7.70±0.82	7.52^{BC}±0.84
	3	7.00±1.06	6.80±0.92	7.10±0.88	6.97^{C}±0.93
	Mean	7.78^{a}±1.00	7.66^{a}±1.06	7.68^{a}±.86	
		LSD for treatments		0.7	

		LSD for storage periods		0.8	
Texture	Zero time	8.70±0.48	8.40±0.70	8.00±0.67	8.37ᵃ±0.67
	1	8.50±0.53	7.80±0.63	8.00±0.47	8.10^{AC}±0.61
	2	7.50±1.08	7.56±0.76	7.50±0.85	7.52^{BC}±0.88
	3	7.00±0.67	7.20±0.92	7.30±0.95	7.10^{C}±0.83
	Mean	7.93^{a}±1.00	7.74^{a}±0.85	7.70^{a}±.79	
		LSD for treatments		0.6	
		LSD for storage periods		0.7	
Overall acceptability	Zero time	8.53±0.55	8.65±0.84	8.10±1.01	8.43^{A}±2.32
	1	8.35±0.20	8.05±0.48	8.06±0.43	8.15^{AB}±1.58
	2	7.73±0.87	7.60±0.50	7.50±0.31	7.61^{B}±2.89
	3	7.40±0.60	7.35±1.65	7.40±1.16	7.38^{B}±2.08
	Mean	8.00^{a}±0.20	7.91^{a}±0.71	7.76^{a}±2.25	
		LSD for treatments		0.7	
		LSD for storage periods		0.3	

LSD= Least Significant Difference (P≤0.05), KTU= kobeba from tuna meat in the external and internal filling, KSH= kobeba from tuna meat in the external filling and shrimp meat in the internal filling, KSQ= kobeba from tuna meat in the external filling and squid meat in the internal filling

Finally, despite the decrease of sensory properties with the increase of storage period, all fish kobeba treatments were acceptable until the end of the storage period at – 18°C.

Conclusions

According to pervious results, fish kobeba samples with tuna, squid and shrimp meat are accepted even after frozen storage at -18ºC for 3 months. It can be manufactured on a commercial basis, with high-quality marine food sources.

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تقييم جودة وقبول الكبيبة المصنعه من لحوم الاسماك المختلفه

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اجريت هذه الدراسه بهدف تصنيع منتج الكبيبة من لحم أسماك التونه ,الجمبرى والسبيط. وقد تم تصنيع ثلاث معاملات من كبيبة السمك وهى المعامله الأولى (تصنع من لحم التونه فى الشكل الخارجي والحشو الداخلى) و المعامله الثانيه (تصنع من لحم التونه فى الشكل الخارجى والجمبرى فى الحشو الداخلى) و المعامله الثالثه (تصنع من لحم التونه فى الشكل الخارجي و السبيط فى الحشو الداخلى). أجريت الاختبارات الفيزوكيميائيه و الخواص الميكروبيولوجيه وخواص الطهى والخواص الحسيه. بعد الاطلاع على نتائج هذه الدراسة ، اتضح أن نتائج النيتروجين الكلى المتطاير و الترای میثیل أمين وحمض ثيوباربيوتريك كانت 13.49 مجم / 100 جم و 5.06 مجم / 100 جم و 0.577 مجم مالونالدهيد / كجم في نهاية فترة التخزين. كانت المعامله الاولى أفضل من حيث قيمة pH و القدره على مسك الماء ، لكن المعامله الثانيه كانت أفضل في البلاستيكيه. وكانت نتائج الفقد فى الوزن وعائد الطهى والاحتفاظ بالدهون والاحتفاظ بالرطوبه 22.71 ، 77.29 ، 135.14 و 77.66٪. على التوالى وقد كان العد الكلى للبكتريا فى المعامله الاولى 2.11×10^3 و المعامله الثانيه 2.29×10^3 بينما فى المعامله الثالثة 2.13×10^3 وكان عدد البكتريا المحبه للبروده هى3.15×10^2 و 3.12×10^2 و 2.39×10^2 على التوالى ولم تكتشف بكتريا السلمونيلا و مجموعة القولون فى جميع المعاملات. كانت عينات الكبيبه مقبولة حسيا وعالية الجودة حتى نهاية فترة التخزين. يمكن تصنيعها من مصادر غذائية بحرية عالية الجودة على المستوي التجاري.